AD-A173 450 CIGARETTE SMOKING FIELD-DEPENDENCE AND CONTRAST SENSITIVITY(U) ARMY RESEARCH INST OF ENVIRONMENTAL MEDICINE NATICK MA B J FINE ET AL. 1986 1/1

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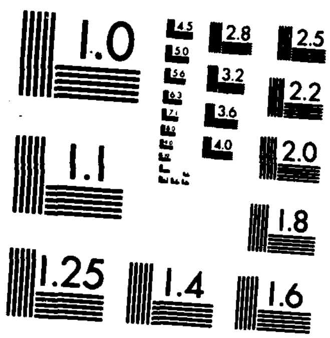

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Cigarette Smoking, Field-Dependence and Contrast Sensitivity

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Running Head: Smoking & Contrast Sensitivity

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Abstract

This study examined the separate and combined effects of cigarette smoking and field-dependence on contrast sensitivity. No previous research on these relationships exists; however, all 3 variables are known to be significantly related to many aspects of human performance.

Twelve smokers and 16 non-smokers were tested for field-dependence and measured for contrast sensitivity (Nicolet CS 2000 Testing System) under carefully controlled conditions.

No differences in contrast sensitivity of smokers were found when measured immediately after smoking 1 cigarette, as compared with having been deprived of smoking for at least 90 min.

Habitual smoking and field-dependence were found to be separately and interactively related to contrast sensitivity. A field-independent non-smoker group performed significantly better than a field-dependent smoker group at all but the lowest spatial frequency.

The results have important implications for many types of performance, particularly aircraft and motor vehicle operation, and may be valuable for use in selection and training.

visual perception; cognitive style; military performance;

Cigarette Smoking, Field-Dependence and Contrast Sensitivity

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This study examines the separate and combined effects of cigarette smoking and field-dependence on contrast sensitivity. As far as can be determined, there has been no previous research on these relationships. The study was accomplished as part of a larger investigation of the effects of cigarette smoking on cognitive, perceptual and motor performance.

Cigarette smoking, field-dependence and contrast sensitivity each have been shown to be significantly related to many important aspects of human perceptual experience (e.g.,16,25,30).

Contrast sensitivity is defined here as the ability to distinguish an object from its background under varying contrast conditions; contrast is the difference in brightness between an object and its background.

Visual acuity, universally regarded as the traditional threshold index of visual resolution (8), represents only one extreme of contrast sensitivity. It depends primarily on the resolution of edge relationships between black and white stimuli at high illumination levels. The Snellen Eye Chart, on which standardized black figures of high spatial frequency are displayed against a highly contrasting white background, is, perhaps, the most familiar example of acuity measurement. A measurement of 20/20 on the Snellen test is regarded as "perfect vision."

However, visual acuity may not be the optimum measure of visual resolution. Recent research (15,16) has shown that pilots who had "perfect" Snellen acuity nevertheless differed from one another in contrast sensitivity. Furthermore, the differences were shown to be related significantly to the

ability to detect targets. Other research (8), among people of equal acuity, has shown contrast sensitivity to be related to differences in ability to discriminate between highway signs at given distances.

These and other research findings have accompanied the recent development of "contrast sensitivity" tests (18,20,27) and reflect the importance of measuring visual resolution throughout the entire continua of both contrast and spatial frequency (3). These newly developed tests are based on the determination of thresholds for the detection of fluctuations in contrast at various spatial frequencies of alternation. The spatial frequencies are stated in cycles/deg of visual angle subtended at the retina. Contrast is defined as Lmax-Lmin/Lmax+Lmin in which Lmax is the highest luminance and Lmin the lowest luminance of the alternation pattern. The reciprocal of this contrast value typically is plotted as contrast sensitivity.

The contrast sensitivity function (CSF) is generally considered to be based mainly on the physiological phenomenon of bleaching of photoreceptor pigments. As a simplified example, if the foreground of a display is darker than the background, then the photoreceptor pigments involved in central fixation are bleached less than those of the paracentral areas.

The virtually infinite variety of spatial detail contained in the viewing field generates spatial frequencies and contrasts which vary from moment to moment. In terms of this fluctuating array, the visual world can be conceptualized as an ever-changing configuration of textures composed of brightness-contrast relationships, in which the variable array triggers contrast sensitivity responses.

The limiting parameters within which this function can occur are determined by the physical characteristics of the prevailing field of view and by personal perceptual characteristics of individual viewers. Our past

research with the variable called "field-dependence" has led us to infer some potentially important relevant characteristics of perceivers, and, hence, to include that variable in the present study.

Field-dependence generally is defined operationally by tests that measure it (e.g. Hidden Figures Test and Rod-and-Frame Test, 29; Hidden Shapes Test, 7). As used here, it is defined by performance on the Gottschaldt Hidden Shapes Test (7) which measures the ability to perceive a simple geometric shape, e.g., a triangle, which is embedded (hidden) in a more complex geometric figure. Individuals differ greatly from one another in their ability to distinguish the simple shape from the more complex background. Persons better able to discriminate the figure from its background, or "field," are referred to as "field-independent," whereas those who have difficulty in making the discrimination are described as being "field-dependent."

Since the discovery of these differences by Witkin (29), a large, essentially descriptive, literature has evolved and numerous significant relationships have been discovered between field-dependence and a wide range of psychological dimensions and behaviors. However, little or no consideration has been given to possible underlying "causes" of these relationships. The individual differences in "cognitive style", as they have come to be called, generally are assumed to originate in early childhood situations and experiences.

Fine (11) conceptualized differences among individuals on the field-dependence-independence dimension as representing basic, probably genetic, differences in the development of their nervous systems. This development was conceived to proceed along dimensions which enable the organism to become progressively better able to discriminate among, organize and integrate neural responses to incoming stimuli. It may be manifested by

such factors as the number, size, location, responsiveness and/or organization of neurons, for example, and modulated by the amount and quality of neural transmitter or other substances at the cellular level. The presumably higher level of development or greater "sensitivity" of the nervous systems of field-independent persons was assumed to be responsible for their better performance on the Hidden Shapes Test. Fine predicted that this "sensory superiority" should manifest itself in better performance on other perceptual tasks which require fine discriminations to be made. Subsequent studies (12,13,14), using a highly standardized and very sensitive test of color discrimination (10), verified the marked superiority of groups of field-independent persons over groups of field-dependent persons in discriminating among colors. Lesser, but, nevertheless, consistent results also were obtained with a relatively insensitive weight discrimination task.

The inclusion of a contrast sensitivity measure in the present study provided an opportunity to investigate differences between field-dependent and field-independent groups on yet another perceptual dimension in which fine differences in discrimination could be measured. Consistent with the foregoing assumptions, it was predicted that field-independent persons would be more sensitive to contrast (indicated by higher contrast sensitivity scores) than would field-dependent persons.

While effects of tobacco smoking on health generally are well known and quite clearly defined, the effects of smoking on human performance are much less clearcut (17,19,28). Smoking has been found to facilitate some types of performance, but to seriously impair other types. As far as we can determine, there has been no research conducted on the effects of cigarette smoking on contrast sensitivity. Given the widespread incidence of smoking in the military (52-53% smokers; 5) and recently established important relationships

between contrast sensitivity and aspects of military performance (15,16), a systematic investigation of the relationship between the two variables seemed advisable.

Method

Participants: The participants were 25 military and 3 civilian volunteers, and included 3 females. Ages ranged from 19-40 years (Mean =23.8; median =23; 1 person older than 29 years). Twelve participants were cigarette smokers (10 or more cigarettes/day) and 16 were non-smokers.

Procedure: Each person participated on 3 different days. The first session involved instruction and actual performance on each task. Thereafter,the participants were tested individually on 2 successive mornings or afternoons. Tasks were organized into groups which were localized at several "stations." The participants proceeded, individually, from station to station every 30 min.

The first 90 min of each of the 2 experimental sessions was devoted to the administration of written tests of personality and cognitive style and to completing questionnaires about smoking habits and demographic characteristics. Each participant then was assigned to 1 of 4 stations and performed the required tasks for 25 min. After a 5-min rest break, they moved to another station. This pattern was continued for 2 hours, until all participants had performed at all stations.

Time of testing and the order in which the tests were taken on each day were kept constant for each participant. However, the procedure during the 5-min rest periods differed from day to day for the smokers. Half of the smokers were required to smoke 1 of their own cigarettes during each of the 5-min rest periods on the first day and were deprived of smoking on the second

day. The other half of the smoker group followed the opposite regimen, smoking on the second day and being deprived on the first.

On a deprivation day, smokers were not permitted to smoke before, during or after the initial 90-min session in which they worked on written tests and questionnaires. Thus, all smokers in the deprivation condition were deprived of smoking for at least 90 min prior to performing tasks at the various stations. The extent of deprivation prior to performing the contrast sensitivity task varied from 90-180 min, depending upon the order of assignment to the work stations. These differences in duration of deprivation were assumed to average out among the smokers. Smoking was done in an area removed from non-smokers.

Measures: (a) Field-dependence was measured by performance on the Gottschaldt Hidden Shapes Test (7). Participants were classified as *field-dependent, central or field-independent* on the basis of norms established from test scores of over 1000 military personnel tested by the investigators in past years. Persons with scores in the lower third of that distribution (19 or below) were categorized as field-dependent. Those scoring in the upper third of the distribution (27 or higher) were categorized as field-independent. The remainder of the group were referred to as "field-central." (b) Contrast sensitivity was measured with the Vistech System (27), Arden plates (18) and with the Nicolet CS 2000 Contrast Sensitivity Testing System(20). Since no significant results were obtained with either the Vistech system or the Arden plates, only the Nicolet System will be described in detail. The system, as employed, used the standard von Bekesy tracking method. This "standard" test consists of 8 separate trials, in each of which a single sinusoidal grating is presented to the observer, seated 3 m from a CRT screen. The first 2 trials, in which gratings of 0.5 and 6 cycles/deg of

visual angle are presented, are used to provide practice for the observer. The remaining 6 trials are data collection trials with gratings of 0.5, 1, 3, 6, 11.4 and 22.8 cycles/ deg.

In the standard test, each trial began with a preview display of the grating pattern to be perceived during that trial. The onset of the preview display was accompanied by a pair of tones to signal the observer. Contrast of the preview pattern was increased from zero to maximum in 1 s, according to a cosine function, remained at maximum for 2 s, then decreased to zero, also according to a cosine function. Two tones signaled the end of the preview.

Another tone then signaled the beginning of the main test. The previewed grating was first presented at zero contrast. Contrast then was automatically increased until the observer depressed a button to signal that the grating had become visible. The observer kept the button depressed as long as he could see the grating. Concurrently, the instrument decreased the grating contrast until the observer released the button on the response box indicating that he could no longer see the grating. By alternately raising and lowering contrast in response to the observer's signals, the instrument tracked the threshold for seeing the particular grating. Testing continued for a total of 4 presses and 4 releases of the response button. The instrument then summarized the performance, printed out a summary and signaled the start of the preview trial for the next, and different, spatial frequency.

Results

Smoking and CSF: The study design permitted 2 types of smoking comparisons: (a) smokers when smoking compared with when deprived of smoking and (b) smokers compared with non-smokers.

Figure 1 shows the CSF's of smokers when they smoked immediately before their performance of the task compared to when they were deprived of the opportunity to smoke. No significant differences were found at any spatial frequency; the 2 curves are virtually identical.

INSERT FIGURE 1 ABOUT HERE

Because their performance when smoking did not differ from when they were deprived, the contrast sensitivity measurements for the group of smokers were averaged across smoking and non-smoking sessions for purposes of comparison with the data of the group of non-smokers. The data for the non-smokers also were averaged across both test days, an analysis of variance (ANOVA) having shown no significant differences in contrast sensitivity between the 2 performances of the non-smoker group.

The results of the comparison of these 2-day averages of smokers with those of non-smokers are shown in Figure 2. A series of t-tests indicated that the group of non-smokers had significantly higher mean contrast sensitivities at frequencies of 3 cycles/deg (p=.09, 2-tails) and 6 cycles/deg (p=.06, 2-tails) and near significant superiority at 22.8 cycles/deg (p=.12, 2-tails).

INSERT FIGURE 2 ABOUT HERE

Field-dependence and CSF: No differences in performance were found between field-independent and field-central groups. Therefore, their scores were combined for comparison with the field-dependent group. (For purposes of this paper, the combined groups will be referred to as the "field-independent" group.) The results of this comparison are shown in Figure 3. A series of t-tests indicated that the predicted relationship between field-independence and contrast sensitivity was substantiated. The "field-independent" group had significantly higher mean contrast sensitivity levels at all spatial

frequencies. The p-values (all 1-tail) for the .5, 1, 3, 6, 11.4 and 22.8 spatial frequencies were .07, .002, .002, .002, .05 and .10, respectively.

INSERT FIGURE 3 ABOUT HERE

Smoking, field-dependence and CSF: Having found that both smoking and field-dependence were related to contrast sensitivity, we next examined their interaction with that variable. The results are shown graphically in Figure 4.

INSERT FIGURE 4 ABOUT HERE

One-way ANOVA's of the data for the 4 sub-groups shown in Figure 4 yielded significant F's for all but the lowest and highest spatial frequencies. Least Significant Difference tests (4,23) indicated that, as expected, at all spatial frequencies except the lowest, the "field-independent" non-smoker group had signficantly higher mean contrast sensitivity scores than the field-dependent smoker group.

The means of the 4 groups and the p values associated with the various comparisons are shown in Table 1.

INSERT TABLE 1 ABOUT HERE

While the number of cigarettes smoked per day by smokers varied from 10 to over 40, no relationships were found between amount of smoking and any of the measures noted above. No relationship was found between field-dependence and cigarette smoking (r=.01).

Discussion

Under the conditions of this study, no differences in the contrast sensitivities of a group of smokers were found when measured immediately after smoking 1 cigarette as compared to when deprived of smoking for at least 90 min.

Both habitual cigarette smoking and field-dependence were found to be related to contrast sensitivity: the non-smoking group had significantly

higher contrast sensitivity levels than the smoking group at spatial frequencies of 3, 6 and 22.8 cycles/deg, and the field-independent group had significantly higher contrast sensitivities than the field-dependent group at all spatial frequencies.

Analysis of the interaction between smoking, field-dependence and contrast sensitivity revealed extremely large and significant differences between field-independent non-smokers and field-dependent smokers at all spatial frequencies except the lowest.

Beyond the limitations of this small study, these results have implications for both theoretical and applied areas of psychology and human performance. For example, as noted previously, Ginsburg et al. (15,16) found that pilots with poorer contrast sensitivity were less effective at detecting targets than were pilots with good contrast sensitivity, although all had good Snellen acuity. While we can find no directly related studies, we believe that Ginsburg's research suggests that it is reasonable to expect that pilots with poor contrast sensitivity also might be at greater risk for accidents when flying under conditions of mist, smoke, fog or white-out or when flying at dawn or dusk. Therefore, our finding of an adverse relationship between smoking and contrast sensitivity, while not establishing causality, nevertheless raises a very serious question about the compatibility of being both a smoker and a pilot. Further research is needed, both to substantiate the effect of smoking on CSF, and to relate both smoking and CSF to actual flight operations.

The strong interactive relationship we have found between field-dependence, smoking and contrast sensitivity dramatically illustrates the extent to which the CSF can vary systematically from one type of person to another and has especially important implications for the study of motor

vehicle accidents. On the basis of our research, one would expect field-dependent smokers to be impaired perceptually when driving under conditions of poor contrast and illumination. Significantly, various degrees of relationship already have been reported between field-dependence and motor vehicle accidents (2), alcoholism (21), color discrimination (12,13,14), and age (22), between age and CSF (24) and age and color discrimination (26) and between alcoholism and color discrimination (6). Thus, accidents by drivers who are field-dependent, elderly and/or alcoholic and who smoke may be better understood as failures in perception.

As noted in the introduction, we conceptualize "field-dependence" primarily as reflecting biologically given differences in the development of the nervous system; in our judgment, differences between individuals of the magnitude we have obtained on the Hidden Shapes Test, color discrimination test and in contrast sensitivity are difficult to account for by environmental factors such as child-rearing practices, differential stimulation in early childhood, etc., although those factors may be of importance. [We note here that the relationship between field-dependence and color discrimination ability referred to previously (12,13,14) was again obtained in this study; the field-independent group made significantly ($p < .05$, t-test) fewer errors on the Farnsworth-Munsell 100 Hue Test (10) than did the field-dependent group.]

Given our conceptualization of differences between individuals in "sensitivity" of the nervous system, it was of special interest to find that while field-dependence (i.e., performance on the Hidden Shapes Test) was significantly related to both CSF and color discrimination, the latter 2 variables were not at all related to one another (r's= .03, .05, -.29, -.10, .03, and -.02 for the .5, 1, 3, 6, 11.4 and 22.8 spatial frequencies,

respectively). This suggests that "sensitivity" might not only vary between people, as we have assumed, but also between and even within the sensory systems of a given individual. Thus, an individual with highly developed ocular color sensitivity concommitantly may have poorly developed cortical color integration capability. Another individual may have the opposite configuration. A third person may be gifted with superior color sensitivity at all levels, but may have a relatively poor system for perceiving contrast, at the ocular level, the cortical level, or both, and even this may vary with spatial frequency, and so on throughout all of the sensory systems. Given these inter- and intra-individual differences in the development and function of various aspects of the nervous system, complex differences between individuals in the quantity and quality of information that has to be processed and the manner in which it is organized, integrated and responded to undoubtedly follow.

We have dwelt at some length on this matter because we believe that how these complex individual differences and their origins are perceived has a strong influence on how science is applied to the solution of problems. It seems to us that if individual differences in behavior are attributed to environment, then there is an implicit assumption that individuals are relatively homogeneous, biologically, and can be modified in similar ways by such external manipulations as training and conditioning. If one uses auto accidents as an example, then solutions to the problem take the form of such things as training "good" driving "habits." However, if individual differences in behavior are considered to be predominately genetically based, then problem solving appears to us to be infinitely more complicated. Solutions must take into account complex differences in relatively unmodifiable innate abilities. Referring to auto accidents again, we must ask what it means

phenomenologically to have poor contrast sensitivity, poor ability to discriminate colors, or poor distance judgment ability, for example, and we must develop large data bases and establish principles and norms with which to modify such things as vehicles, highways, road signs and lighting to tolerances that can accommodate much wider ranges of human abilities than at present.

As noted above, there presently appears to be a significant convergence of research areas involvng complex relationships between smoking, field-dependence, aging, contrast sensitivity, color discrimination, alcoholism and human performance. To capitalize on this body of information and move forward effectively, unifying concepts are badly needed. We believe that the origin of such concepts lies somewhere in a consideration of the bases of differences between individuals. We express our concern here because we perceive that the focus of most researchers is not in that direction.

Footnotes and acknowledgements

The views, opinions and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation. Persons participating in this study did so only after giving their free and informed voluntary consent. Investigators adhered to AR 70-25 and USAMRDC Regulation 70-25 on Use of Volunteers in Research.

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References

1. Adams AJ, Brown B, Haegerstrom-Portnoy G, Flom MC, Jones RT. Evidence for acute effects of alcohol and marijuana on color discrimination. Perc. Psych. 1976; 20:119-24.

2. Arbuthnott DW. Effects of noise and perceptual style on reaction to simulated driving emergency. Canad. J. Behav. Sci. 1980; 12:78-86.

3. Arden GB. The importance of measuring contrast sensitivity. Br. J. Ophth. 1978; 62:198-209.

4. Boardman TJ, Moffitt DR. Graphic Monte Carlo Type I error for multiple comparison procedure. Biometrika. 1971; 27:738-44.

5. Bray RM, Guess L, Mason R, Hubbard R, Smith D, Marsden M, Rachal J. 1982 worldwide survey of alcohol and nonmedical drug use among military personnel. Raleigh, NC: Research Triangle Institute, July, 1983.

6. Burdick JA, Chebib FS. Heredity, color vision and alcoholism. Int. J. Addic. 1982; 17:815-22.

7. Cattell RB, Baggaley AR, Checov L, Cogan EA, Flint D, Gruen W, Husek E, Meeland T, Saunders DR, Schiff H. The Objective-Analytic Personality Factor Batteries. Champaign, IL: Institute for Personality & Ability Testing, 1955.

8. Dismukes K. Recommended standard procedures for the clinical measurement and specification of visual acuity; report of Working Group 39, NAS-NRC Committee on Vision. Adv. Ophthal. 1980; 41:103-48.

9. Evans DW, Ginsburg AP. Contrast sensitivity predicts age-related differences in highway sign discriminability. Human Fact. 1985; 27:637-42.

10. Farnsworth D. Manual for the Farnsworth-Munsell 100-Hue Test for the examination of color discrimination. Baltimore: Munsell Color Co., 1957.

11. Fine BJ. Field-dependent introvert and neuroticism: Eysenck and Witkin united. Psychol. Rept. 1972; 31:939-56.

12. Fine BJ. Field-dependence-independence as "sensitivity" of the nervous system: supportive evidence with color and weight discrimination. Perc. Mot. Sk. 1973; 37:287-95.

13. Fine BJ. Field-dependence and color discrimination ability in females. Perc. Mot. Sk. 1983; 57:983-86.

14. Fine BJ, Kobrick JL. Field-dependence, practice and low illumination as related to the Farnsworth-Munsell 100-Hue Test. Perc. Mot. Sk. 1980; 51:1167-77.

15. Ginsburg AP, Easterly J, Evans DW. Contrast sensitivity predicts target detection field performance of pilots. Proc. Hum. Fact. Soc. Ann. Mtg. 1983; 269-73.

16. Ginsburg AP, Evans D, Sekuler R, Harp S. Contrast sensitivity predicts pilots' performance in aircraft simulators. Am. J. Optom. 1982; 59:105-09.

17. Heimstra NW, Bancroft NR, DeKock AR. Effects of smoking upon sustained performance in a simulated driving task. Ann. NY. Acad. Sci. 1967; 142:295-307.

18. Kobrick JL, Zeltzer HI, Mullen S. A system for controlled presentation of the Arden Contrast Sensitivity Test. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Rept. No. T3/86; December, 1985.

19. Myrsten A-L, Andersson K, Frankenhaeuser M, Elgerat A. Immediate effects of cigarette smoking as related to different smoking habits. Perc. Mot. Sk. 1975; 40:515-23.

20. Nicolet CS 2000 Contrast Sensitivity System. Madison, WI: Nicolet Instrument Co., 1982.

21. O'Leary MR, Donovan DM, Chaney EF. The relationship of perceptual field orientation to measures of cognitive functioning and current adaptive abilities in alcoholics and nonalcoholics. J. Nerv. Ment. 1977; 165:275-82.

22. Panek PE. Age-differences in field dependence/independence. Exp. Aging R. 1985; 11:97-99.

23. Pearson ES, Hartley HO. Biometrika tables for statisticians. Vol. I., London: Cambridge University Press, 1958.

24. Sekuler R, Owsley C. The spatial vision of older humans. In: Sekuler R, Kline D, Dismules K, eds. Aging and human visual function. New York: Alan R. Liss, Inc., 1982: 185-202.

25. Tong JE, Knott VJ, McGraw DF, Leigh G. Smoking and human experimental psychology. B. Br. Psycho. 1974; 27:533-38.

26. Verriest G, Vandevyvere R, Vanderdonck, R. Nouvelles recherches se rapportant a l'influences du sexe et de l'age sur la discrimination chromatique ainsi qu'a la signification pratique des resultats du test 100 Hue de Farnsworth-Munsell. Revue Opt. (Paris) 1962; 10:499-509.

27. Vision Contrast Test System. Dayton, OH: Vistech Consultants, Inc., 1985.

28. Wesnes K, Warburton DM. The effects of cigarette smoking and nicotine tablets upon human attention. In: Thornton RE, ed. Smoking behaviour: physiological and psychological influences. Edinburgh: Churchill Livingstone, 1978.

29. Witkin HA, Dyk RB, Faterson HF, Goodenough DR, Karp SA. Psychologial differentiation. New York: Wiley, 1962.

30. Witkin HA, Goodenough DR. Cognitive styles: essence and origins. New York: International Universities Press, 1981.

Table 1

Comparison of Contrast Sensitivity for

Combined Field-dependence and Smoking Groups

		Contrast Sensitivity (cycles/degree)					
Group	N	.5	1	3	6	11.4	22.8
1.Indep./Non-Smoker	10	24.1	157.2	428.9	441.6	164.3	70.8
2.Indep./Smoker	6	28.3	118.2	329.3	346.5	224.7	58.5
3.Dep./Non-Smoker	6	19.7	67.5	254.2	280.0	187.3	63.3
4.Dep./Smoker	6	17.7	65.3	200.5	172.8	73.8	22.5
Significance*		n.s.	1>3,4	1>3,4	1>3,4	1,2,3>4	1>4
				2>4	2>4		

*Least Significant Difference test:-Numbers 1,2,3,4 refer to sub-groups listed in first column; ">" means "significantly different from at <.025 level, 1-tail)."

Contrast Sensitivity of Smokers
When Smoking and Deprived

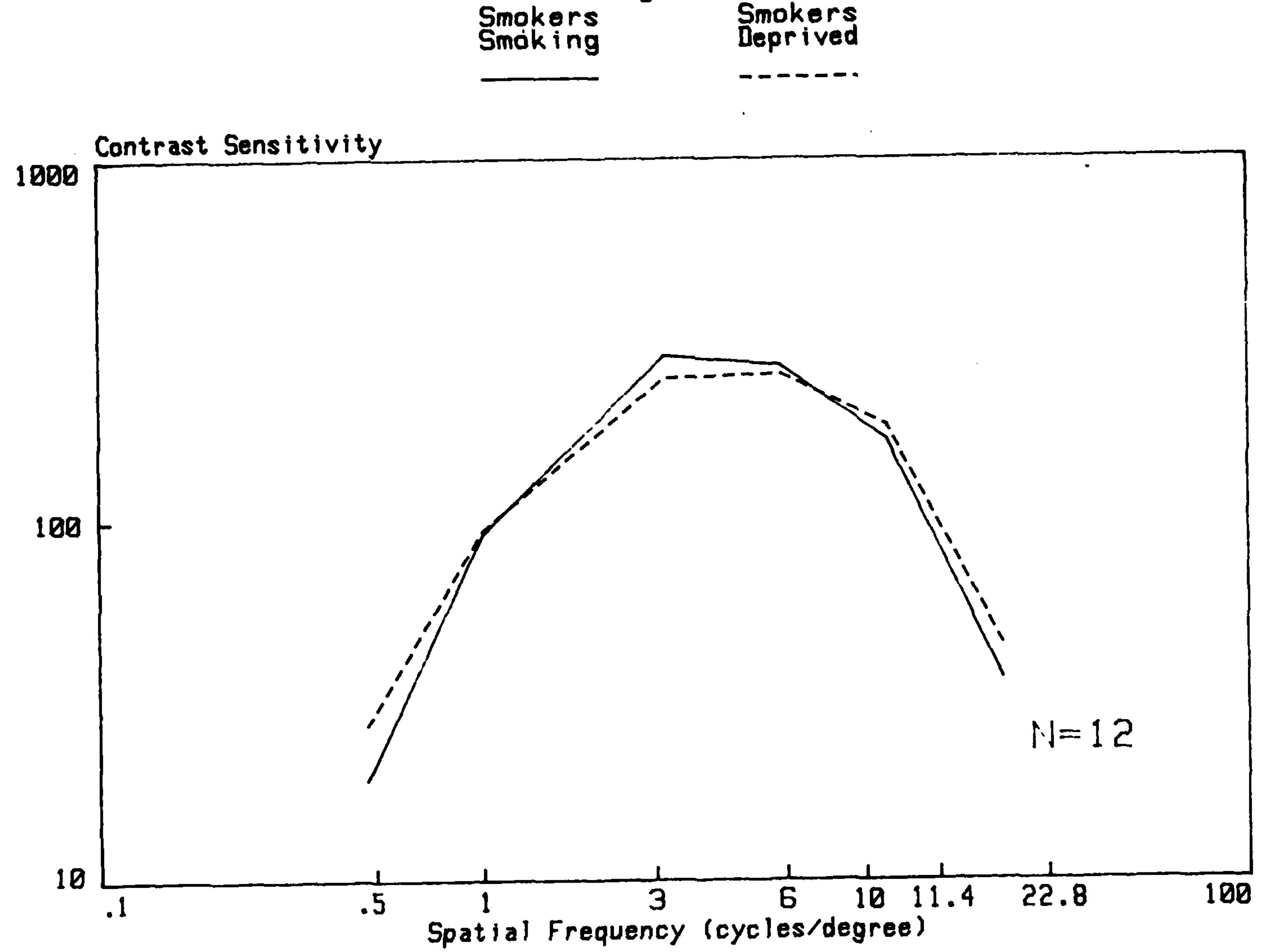


Fig.1

Cigarette Smoking and Contrast Sensitivity

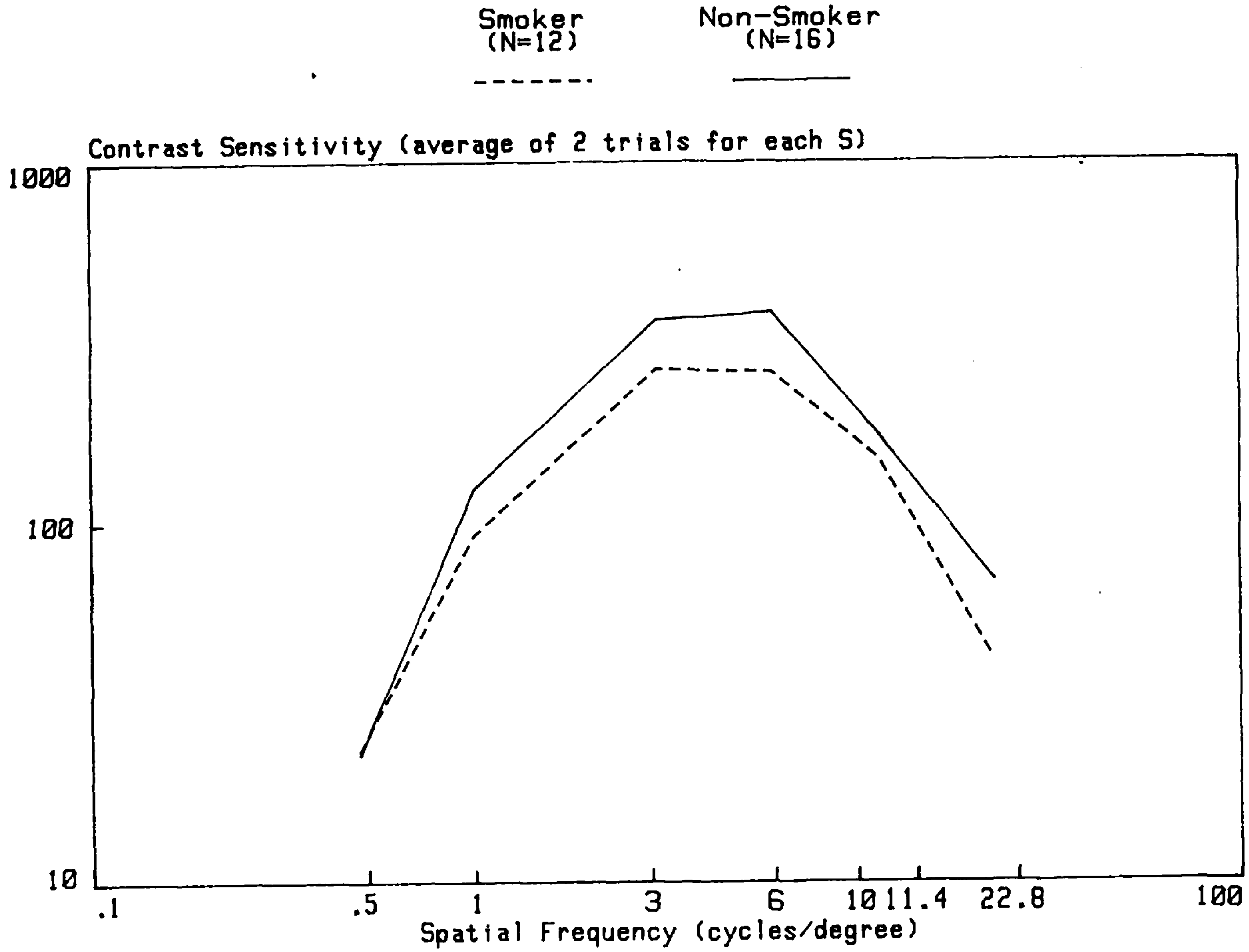


Fig. 2

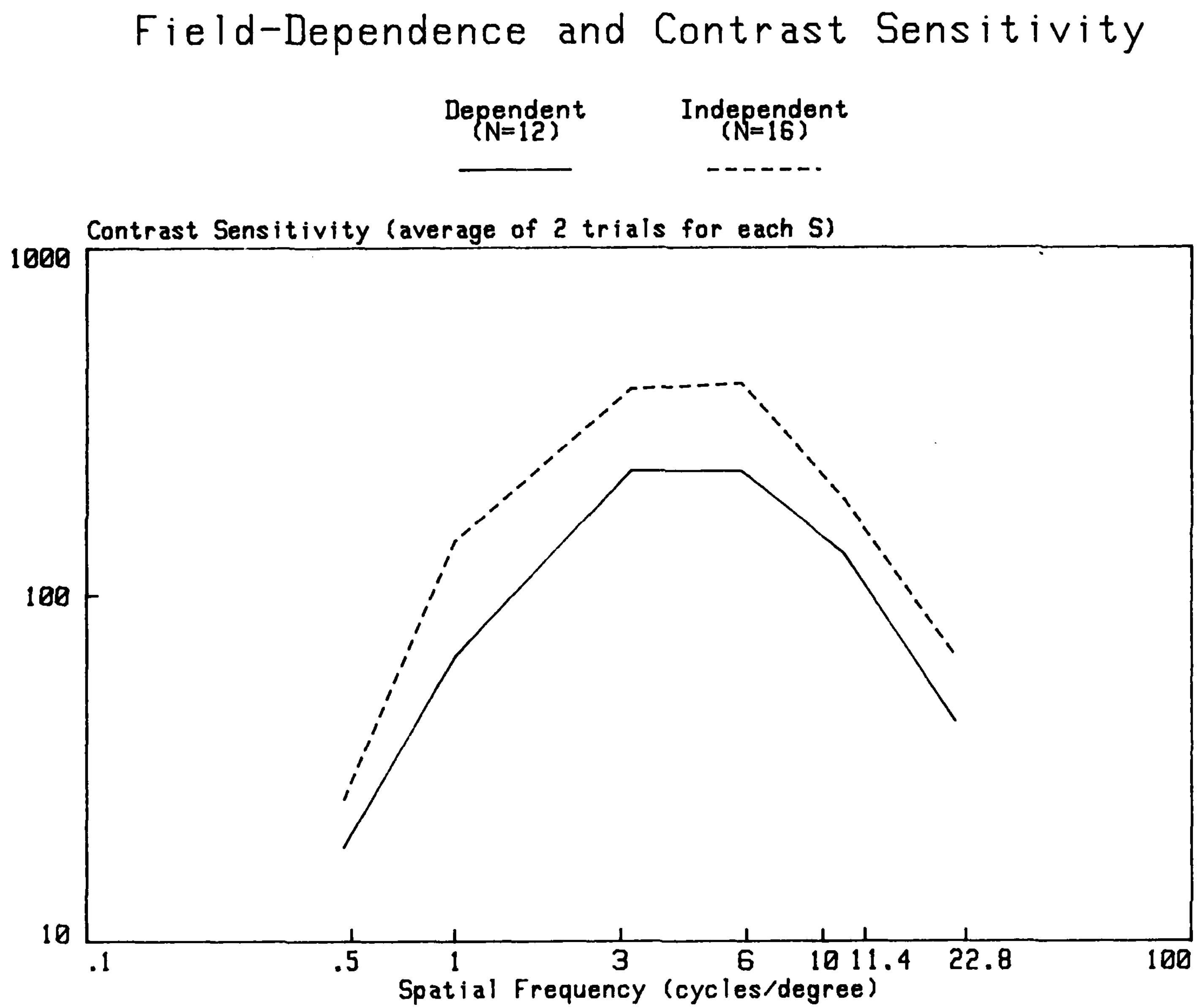
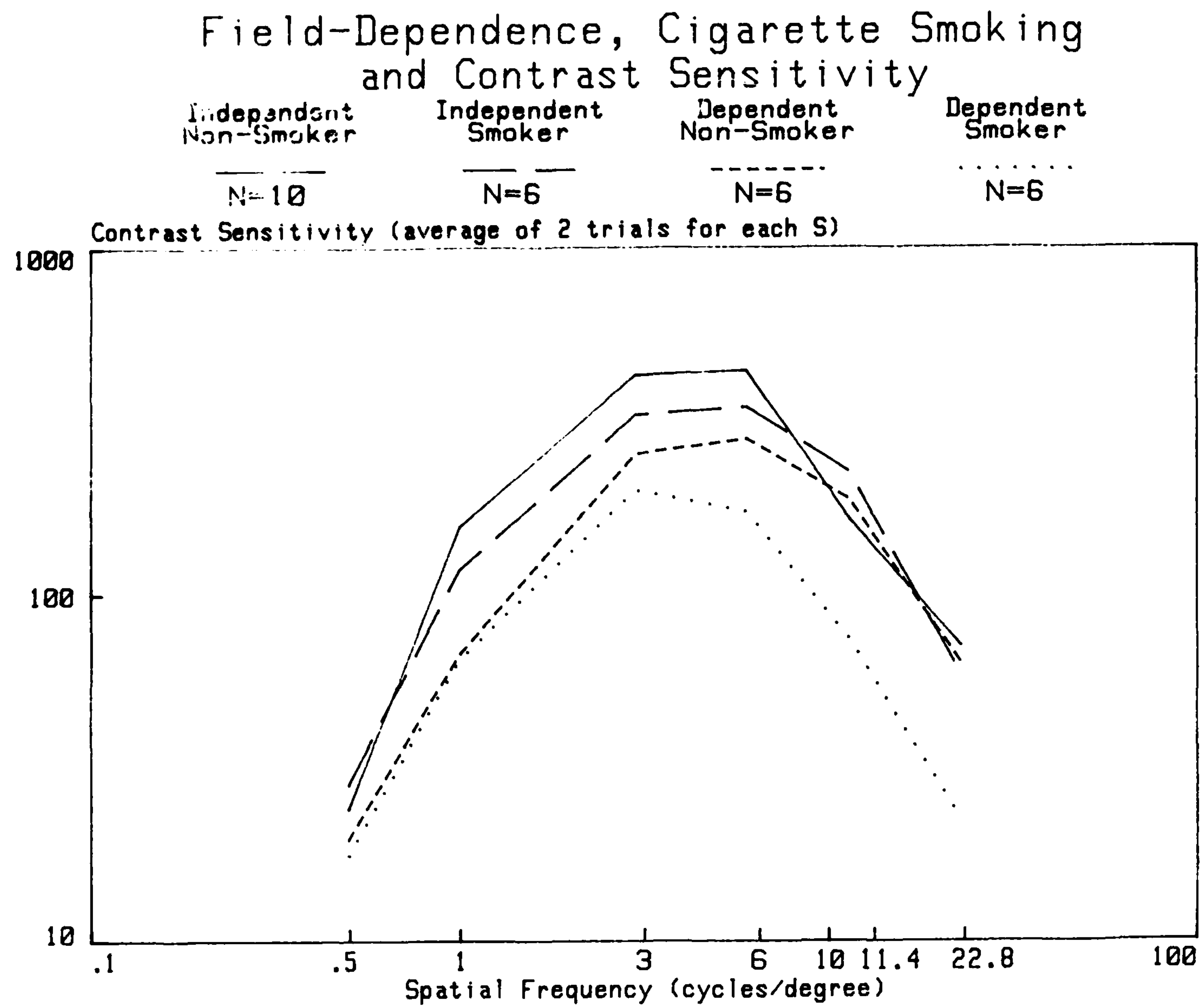

Field-Dependence and Contrast Sensitivity
Dependent (N=12)
Independent (N=16)
Contrast Sensitivity (average of 2 trials for each S)
1000
100
10
.1
.5
1
3
6
10
11.4
22.8
100
Spatial Frequency (cycles/degree)

Fig. 3



Field-Dependence, Cigarette Smoking
and Contrast Sensitivity
Independent Non-Smoker
N=10
Independent Smoker
N=6
Dependent Non-Smoker
N=6
Dependent Smoker
N=6
Contrast Sensitivity (average of 2 trials for each S)
1000
100
10
.1
.5
1
3
6
10
11.4
22.8
100
Spatial Frequency (cycles/degree)

Fig. 4

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